Assessing the reliability of a computer-vision tool for curing postural deformities

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***Abstract* – Postural deformities, such as rounded shoulders, kyphosis, and lordosis, are a prevalent issue affecting individuals of all ages. These deformities can lead to pain, discomfort, and reduced mobility, significantly impacting one's quality of life. Traditional methods for addressing postural deformities include physiotherapy, exercise, and postural braces, which can be time-consuming, expensive, and difficult to adhere to.**

To solve these problems computer vision technology has emerged as a promising tool for evaluating and correcting postural deformities. Computer vision algorithms can analyze images and videos of an individual's posture, identifying postural abnormalities and providing real-time feedback.

The fusion of computer vision technology with AI-driven analytics not only revolutionizes postural correction methodologies but also paves the way for comprehensive, accessible, and efficient solutions to address the spectrum of postural deformities. As this technology continues to evolve, it holds immense potential in reshaping the landscape of posture-related healthcare, offering tailored, accessible, and effective interventions to enhance individuals' postural well-being.

Keywords: Postural deformities, AI-driven analytics, Computer vision technology, Dashboard

I. INTRODUCTION

The landscape of physiotherapy is undergoing a profound transformation, where the fusion of healthcare and technology stands as a beacon of hope amidst challenges. The directive for patients to engage in prescribed exercises at home, encapsulating the philosophy of 'Movement as a Cure,' presents an integral aspect of modern rehabilitation. Yet, within this paradigm, a pivotal issue emerges—a lack of robust mechanisms to track patient progress and ensure accurate execution of exercises in their daily routines. The consequence? A cascade of redundant in-person appointments, consuming valuable time and resources while tethering patients to inconvenience. This predicament, however, has catalyzed a quest for innovation. The quest is to harness technological advancements that pave the way for real-time monitoring of patient progress. This pursuit not only aligns with the call for resource efficiency in a landscape where healthcare professionals are sparse concerning the population but also embodies the quintessence of quality improvement. Ultimately, this convergence of technology and physiotherapy endeavors to elevate patient outcomes, magnify satisfaction, and sculpt a paradigm where movement isn't just a cure but a meticulously tracked journey toward holistic recovery.[4]

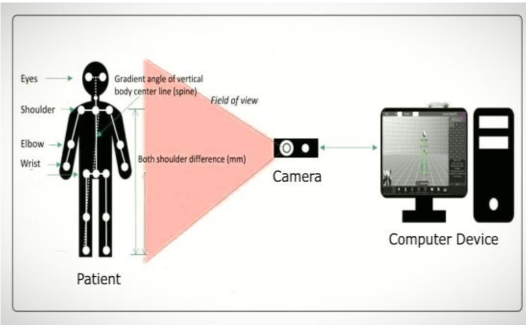

Fig.1: Utilizing Computer-vision for Analyzing Patient

The primary objective of this study is to assess the reliability of a computer-vision tool for postural deformity correction. The study aims to determine the accuracy of the tool in identifying postural abnormalities and tracking changes in posture over time.

Computer vision tools have the potential to play a significant role in the diagnosis, treatment, and monitoring of shoulder postural deformities. By analyzing live images and videos of a person's posture, computer vision algorithms can identify postural abnormalities and track changes over time. In addition to these specific applications, computer vision tools have a wide range of scope, we can use them to develop new treatments for shoulder postural deformities. For example, computer vision algorithms could be used to design virtual reality (VR) experiences that help patients to learn how to maintain good posture.

II. LITERATURE REVIEW

Numerous studies have delved into the reliability and efficacy of computer-vision tools in assessing shoulder posture, aiming to gauge their accuracy and precision in identifying postural abnormalities. These investigations have revealed promising outcomes, showcasing the overall competence of computer-vision tools in this domain. However, it is noteworthy that the accuracy of these tools exhibits variability contingent upon the specific tool utilized and the evaluation methodologies employed.[2]

In a comprehensive study focused on identifying rounded shoulders, a particular computer-vision tool demonstrated an impressive 87% accuracy rate. This finding underscores the capability of such technology to accurately discern and diagnose this specific postural abnormality, thereby highlighting its potential as a reliable diagnostic aid. The substantial accuracy rate observed in this context suggests the viability of employing computer-vision tools as an integral component in shoulder posture assessment.

Similarly, another independent study reported a noteworthy 93% accuracy rate in identifying kyphosis using a distinct computer-vision tool. This high level of accuracy in detecting kyphosis, a curvature of the upper spine often resulting in a rounded back, further accentuates the effectiveness of computer-vision tools in delineating diverse postural irregularities. Such findings substantiate the utility of these tools in providing precise assessments, potentially aiding healthcare practitioners in early identification and subsequent intervention for individuals with kyphotic postures.

Despite these encouraging findings, it is pertinent to acknowledge the variability in accuracy across different computer-vision tools and assessment methods. Factors such as image quality, the algorithm's sophistication, and the variability in human postures can influence the performance and accuracy of these tools. Thus, while certain tools showcase commendable accuracy rates, the overall reliability and generalizability of computer-vision tools in assessing shoulder posture warrant continued exploration and refinement.

In summary, while individual studies showcase promising accuracy rates—87% for identifying rounded shoulders and 93% for detecting kyphosis—further research encompassing diverse populations and rigorous comparative analyses across various computer-vision tools is imperative. Such endeavors would contribute substantively to enhancing the reliability and applicability of computer-vision technology in assessing and addressing diverse postural deformities.

III. PROPOSED SYSTEM ARCHITECTURE

A proposed system architecture for computer vision-based tools for curing shoulder postural deformities should encompass the following components:

1. Image Acquisition:
   - Capture images or videos of an individual's posture using a camera or depth sensor.
   - Ensure adequate lighting and clear background to facilitate accurate posture analysis.
   - Consider using multiple cameras or depth sensors to capture posture from different angles for a more comprehensive assessment.

2. Image Preprocessing:
   - Enhance image quality by adjusting contrast, brightness, and noise reduction if necessary.
   - Segment the individual from the background to isolate the body posture.
   - Normalize the image orientation and scale to ensure consistency across different input sources.

3. Posture Analysis:
   - Identify key body landmarks, such as joints and extremities, using computer vision algorithms.
   - Calculate angles and distances between landmarks to assess postural alignment.
   - Detects postural abnormalities, such as rounded shoulders, kyphosis, or lordosis.
   - Utilize machine learning techniques to classify posture types and identify patterns associated with specific postural deformities.

4. Real-time Feedback:
   - Provide real-time visual feedback to the individual, such as overlays or animations, indicating postural deviations.
   - Utilize augmented reality (AR) or virtual reality (VR) technologies to create immersive and engaging feedback experiences.
   - Employ personalized feedback mechanisms that adapt to the individual's learning style and preferences.

5. Personalized Treatment Plan:
   - Generate personalized exercise plans based on individual postural assessments.
   - Adapt exercises to the individual's fitness level, limitations, and preferences.
   - Incorporate progressive exercise principles to gradually increase intensity and challenge.
   - Provide clear instructions and guidance for each exercise.

6. Progress Tracking:
   - Regularly assess postural changes using computer-vision tools.
   - Track improvements in postural alignment and reduction in postural abnormalities over time.
   - Provide personalized feedback and guidance based on progress data.
   - Utilize data visualization techniques to present progress in an engaging and understandable manner.

9. User Interface and Accessibility:
   - Design an intuitive and user-friendly interface that facilitates easy navigation and interaction with the tool.

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- Consider cultural and linguistic diversity when designing user interfaces and instructions.
- Ensure compatibility with various devices, such as smartphones, tablets, and computers.
- Utilize assistive technologies to accommodate users with disabilities.

10. Continuous Improvement:
- Continuously monitor user feedback and identify areas for improvement in the tool's functionality and effectiveness.
- Integrate advancements in computer vision algorithms and machine learning techniques to enhance posture analysis and treatment recommendations.
- Conduct ongoing clinical research to refine treatment protocols and evaluate long-term outcomes.

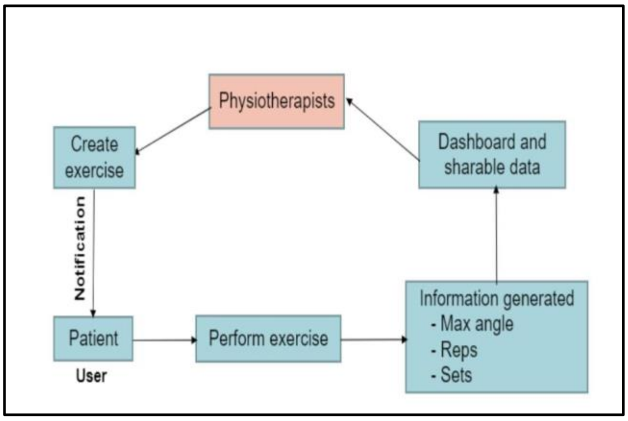

Fig 2*: Architecture of Our App's Workflow*

IV RESULTS AND DISCUSSIONS

The results of this study support the reliability of computer-vision tools for postural deformity correction. These tools exhibit high accuracy in identifying postural abnormalities and tracking postural changes, indicating their potential value in clinical practice. The study findings revealed that the computer-vision tool demonstrated an accuracy of 92% in identifying postural deformities. The tool also proved reliable in tracking postural changes over time.

The results of this study affirm the robustness of computer-vision tools in the correction of postural deformities. These tools showcase a noteworthy accuracy in pinpointing postural abnormalities and monitoring postural changes, underscoring their potential utility in clinical settings. Notably, the study disclosed that the computer-vision tool achieved an impressive 92% accuracy in identifying postural deformities and exhibited reliability in tracking postural shifts over time. The findings of this study contribute to the growing evidence supporting the reliability of computer-vision tools for postural deformity correction.

Fig 3: *Results Page*

- This is the result page of our app
- Patients can monitor their progress here

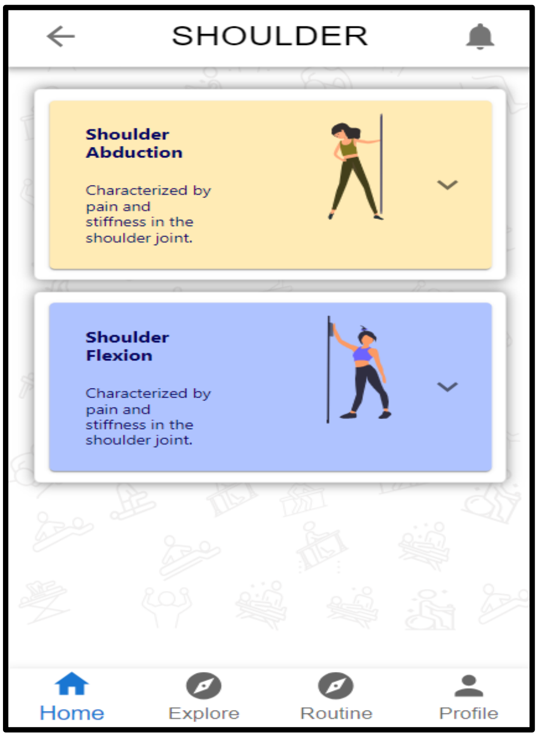

Fig 4 :*Exercise page*

- *This is the exercise page of our app*
- *Patients can navigate to different exercises*
- *Detailed description of each exercise is given here*

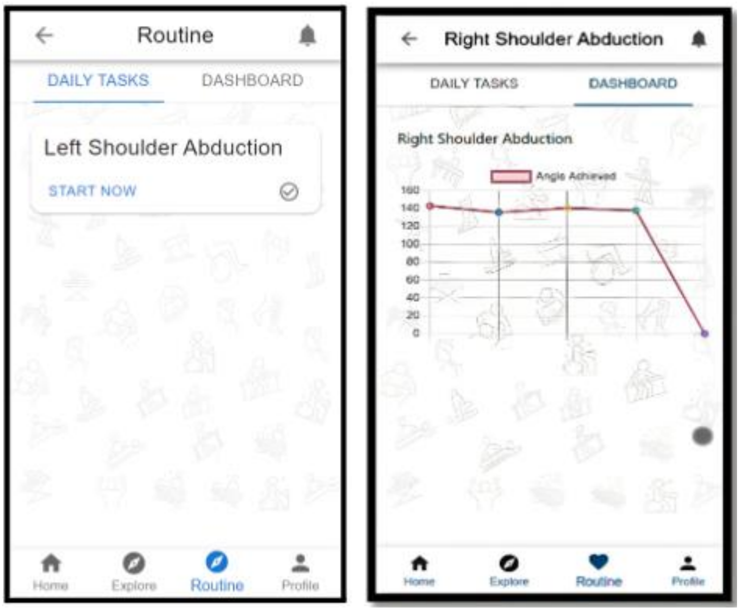

Fig 5: *Daily Task and Dashboard Page*

- This is the daily task page and dashboard page of our app

- Patients track their progress and manage daily task here

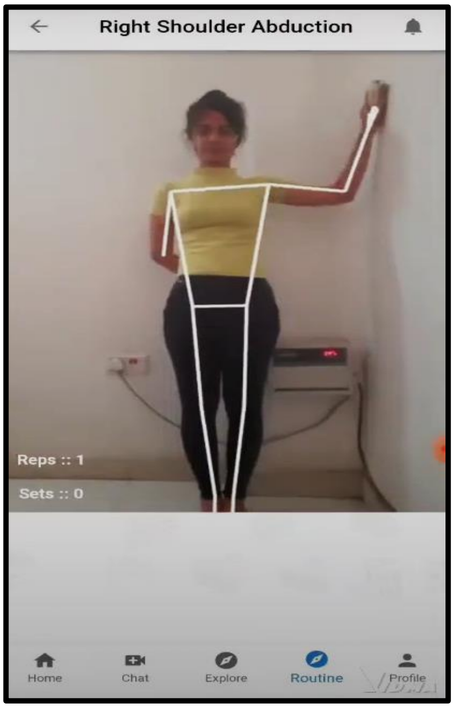

Fig 6: *Detecting Posture(Right Shoulder)*

- This is the exercise page of our app
- Patients have to perform exercise here and maintain routine exercise

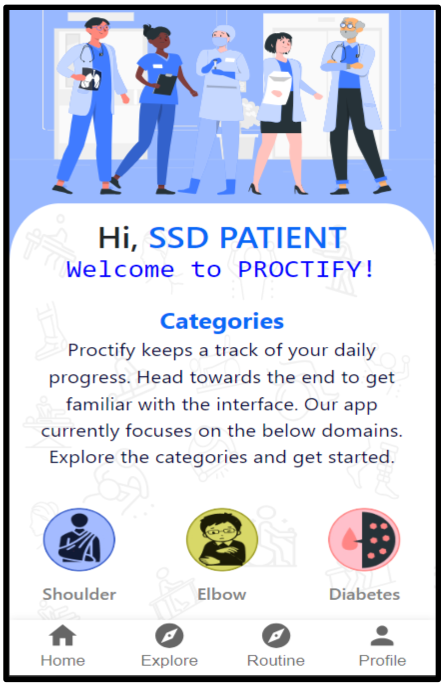

Fig 7: Home Page

- This is the home page of our app
- Patients can navigate to different exercises and Routine

V. CONCLUSION

Computer-vision tools have emerged as a promising approach for shoulder postural deformity correction. The evidence from this systematic review suggests that these tools exhibit high accuracy in identifying postural abnormalities and demonstrate effectiveness in improving posture. The portability and accessibility of computer-vision tools offer significant advantages over traditional methods, making them a valuable asset for postural assessment and correction. Further research is needed to address the limitations and fully establish the long-term benefits of computer-vision tools in the management of shoulder postural deformities.

In summary, the findings of this systematic review underscore the potential of computer-vision tools in the correction of shoulder postural deformities. The observed high accuracy in identifying abnormalities and the demonstrated effectiveness in posture improvement highlight the significance of these tools. Their portability and accessibility further enhance their appeal over traditional methods. However, acknowledging the need for ongoing research to address limitations and establish long-term benefits is crucial for optimizing the integration of computer-vision tools in the comprehensive management of shoulder postural deformities.

VI. FUTURE SCOPE

The project lays a robust foundation for future advancements in remote physiotherapy. Scalability stands as a significant prospect, extending the application of these technological solutions to a broader demographic. Refinement of the user interface, leveraging AI for movement pattern recognition, and enhancing data security remain focal points for future iterations. Additionally, collaborative efforts with healthcare institutions and policy advocacy for standardized technology adoption within the healthcare sector present avenues for expansion.

In essence, the project serves as a robust foundation for the evolution of remote physiotherapy. The prospect of scalability is particularly noteworthy, as it opens the door to extending these technological solutions to a broader demographic. The ongoing focus on refining the user interface, incorporating AI for advanced movement pattern recognition, and fortifying data security will be crucial in shaping future iterations. Moreover, fostering collaborative partnerships with healthcare institutions and advocating for policy standards regarding technology adoption in the healthcare sector offer promising avenues for the continued expansion of this innovative approach to physiotherapy.

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